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INFILTRATION AND BEDDING STUDY FOR
SANITARY SEWERS IN THE GULF COAST
AREA

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Tulane University
New Orleans, Louisiana

24 July 1968

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THE 1968 PROGRESS REPORT

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INFILTRATION AND BEDDING STUDY

for

SANITARY SEWERS IN THE GULF COAST AREA

TULANE UNIVERSITY

DEPARTMENT OF CIVIL ENGINEERING

NEW ORLEANS, LOUISIANA

July 24, 1968

Grant Number - WPD-80-04-68

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Professor of Civil Engineering
and Public Health and
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Health Department

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ACKNOWLEDGMENTS

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The United States Public Health Service, Department of the Interior and the W.S. Dickey Clay Mfg. Company have provided the tangible financial assistance.

The New Orleans Sewerage and Water Board has furnished much labor and the use of equipment as well as technical advise from the start of this project.

Particular acknowledgment is made of the continued help of the East Bank Consolidated Sewerage District of Jefferson Parish, La. in obtaining suitable field testing sites as well as technical advise and the loan of labor and equipment.

The Louisiana Materials Company has been most generous in their gifts of materials for laboratory testing as well as the furnishing of field materials at prices below their costs.

Acknowledgment is made of the technical advise given by the staff of Albert Switzer Engineers Inc.

Particular mention is made of the work done by R. J. L'Hoste and Company who constructed the field test installations at considerable inconvenience and costs.

ANNUAL PROJECT PROGRESS REPORT

1968

This research on sewer beddings for the Gulf Coast area began in 1964. The progress with the project in 1968 may be divided into several areas; the completion of the first laboratory model study, the investigation of new sewer systems constructed in the field, and the completion of various support studies.

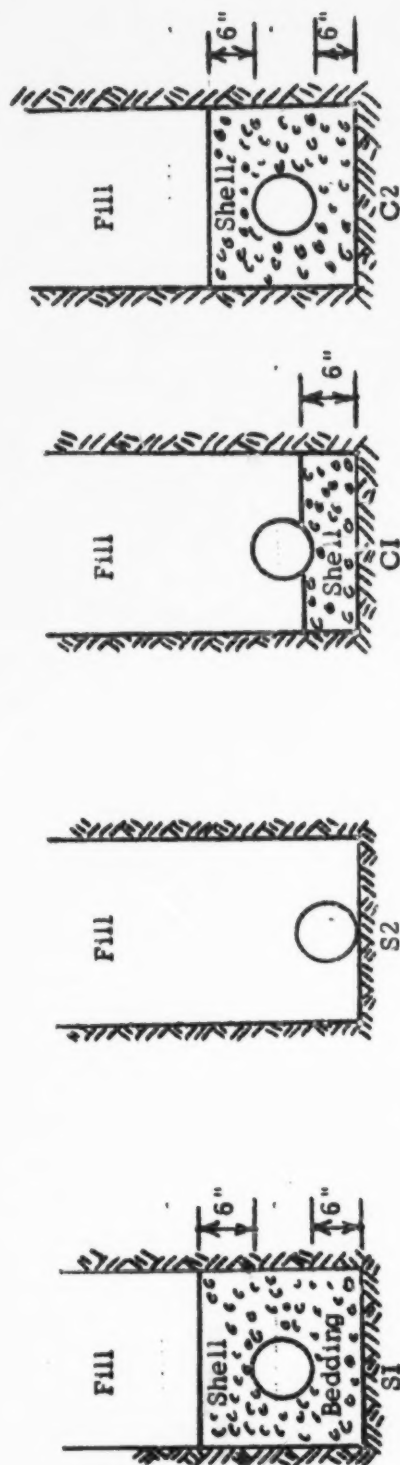
The data from the completed studies are presently being analyzed. These data and analyses will be presented in a forthcoming doctoral dissertation. Certain analyzed data will be presented in this report, but this should, by no means, be considered as complete information or analysis.

Laboratory Model Study

Prior to 1968, model tests had been completed in sandy soil and clay. During 1968, the model tests in organic soil were finished. Fig. 1 shows the respective beddings for the tests in sand, clay, and organic material; and Fig. 2 shows the ultimate net joint settlement of the sewers tested.

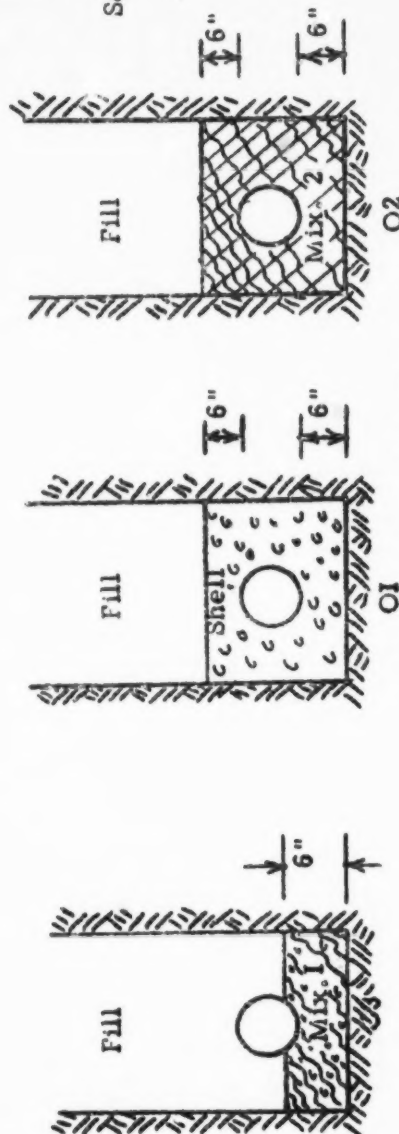
The arrangements for these tests were described in detail in the 1966 annual report.

Although this first laboratory model study has been completed, the data have not yet been completely analyzed nor has an attempt been made at field correlation. This analysis and correlation is at present being processed and will be finished shortly.



Note: All Trenches 19" Wide & All Pipe 8" Clay

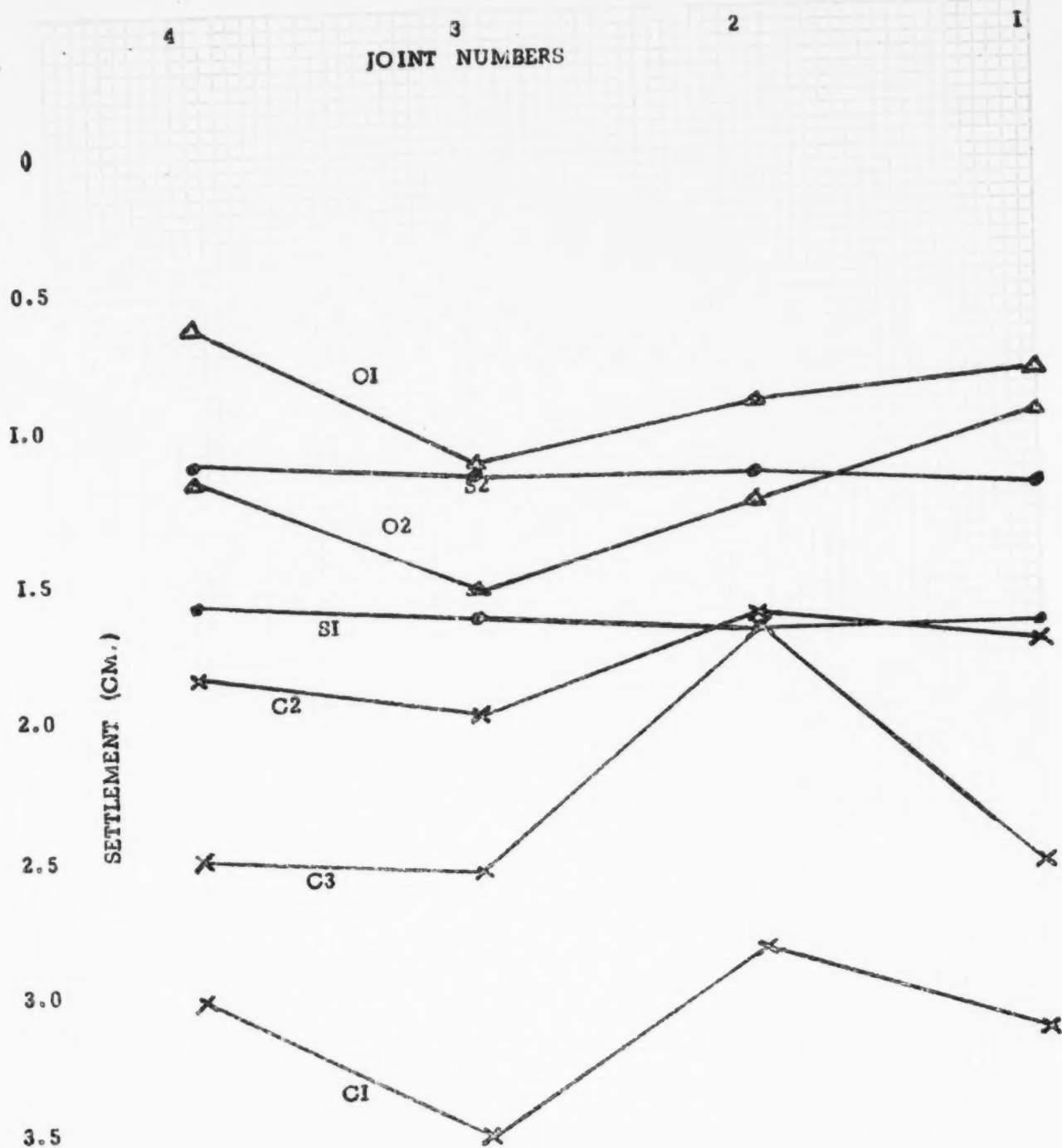
S----- Sandy Soil
 C----- Clay Soil
 O----- Organic Soil
 Mix. 1
 Sand, shell, & cement
 Mix. 2
 Shell & cement



LABORATORY BEDDINGS

FIG. 1

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ULTIMATE JOINT SETTLEMENT
FIG. 2

Field Study

In 1966, a field study was initiated to run concurrently with the laboratory model study. This investigation was undertaken because it was realized that the inherent limiting factors in the model necessitate field correlation for the attainment of meaningful results, and also because only in the field are the true conditions effecting bedding and infiltration experienced.

General Procedure

The field study consists, for the most part, of the installation and observation of test sewers laid in the New Orleans area. Two such sewers have thus far been installed and are presently being observed.

Material control tests were performed on the bedding materials prior to and following their acceptance for field testing.

Locations & Soil Types

The two test sewers have been laid in slightly varying soil under different conditions. Both sewers are in Jefferson Parish Louisiana, one on Iota Street and the other on Hessmer Avenue.

The Iota Street test sewer is a shallow sewer laid in a stratified soil system consisting of layers of soft clay divided by layers and lenses of fine sands and silts. Some organic material and wood is found widely dispersed in the layered system with great frequency at shallower depths.

The water table in this area was found to be quite high, at a depth of approximately 2 feet.

The Hessmer Avenue test sewer is a deep sewer laid in material quite similar to that found in the vicinity of the Iota Street installation. At the depth of the sewer very little organic material and no wood was found. The water table at this site was observed to be at a depth of 2 feet.

Sewer Pipe

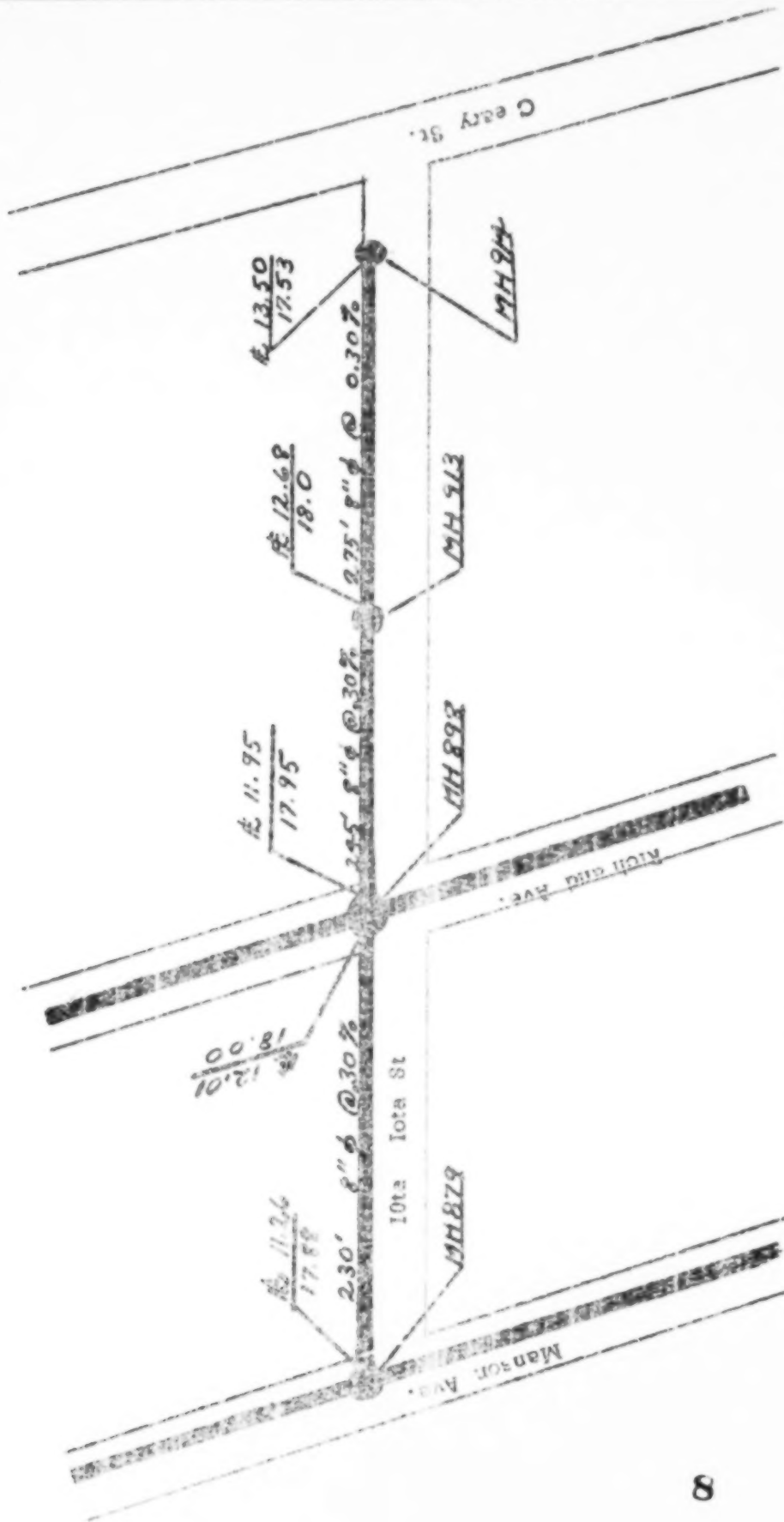
Only eight-inch vitrified clay extra strength pipe, as manufactured by the W. S. Dickey Clay Mfg. Co., is used in this study. By using one manufacturers product, the type of pipe and joint are held as constant factors throughout the study.

Test Sewer Sections

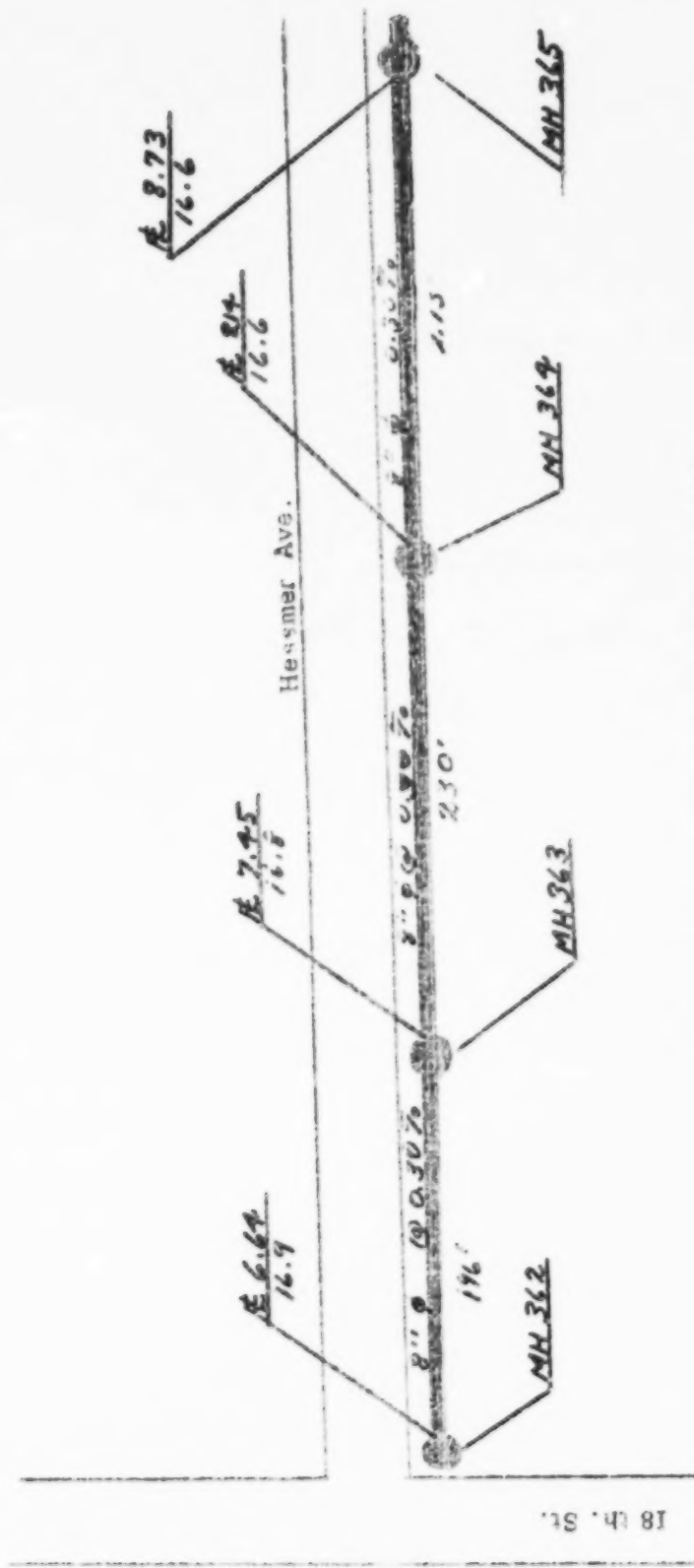
Figs. 3 and 4 show schematic diagrams of the two test sewers. Each test installation consist of three test sections with different beddings.

Bedding Materials

Many materials, and combinations of materials, were initially considered for beddings to be used in the field study. All beddings considered utilized reef shell (clam shells) as the base material. The other components of these potential beddings ranged from portland cement, lime and sand to asphalt, chemical gels, and complex organic soil sealants and stabilizers. Many of these materials were ruled out because of their inherent weaknesses relative to seepage properties and/or shear strength. Others were discarded



IOTA STREET TEST INSTALLATION
FIG. # 3



HESSMER AVENUE TEST INSTALLATION
FIG. 4

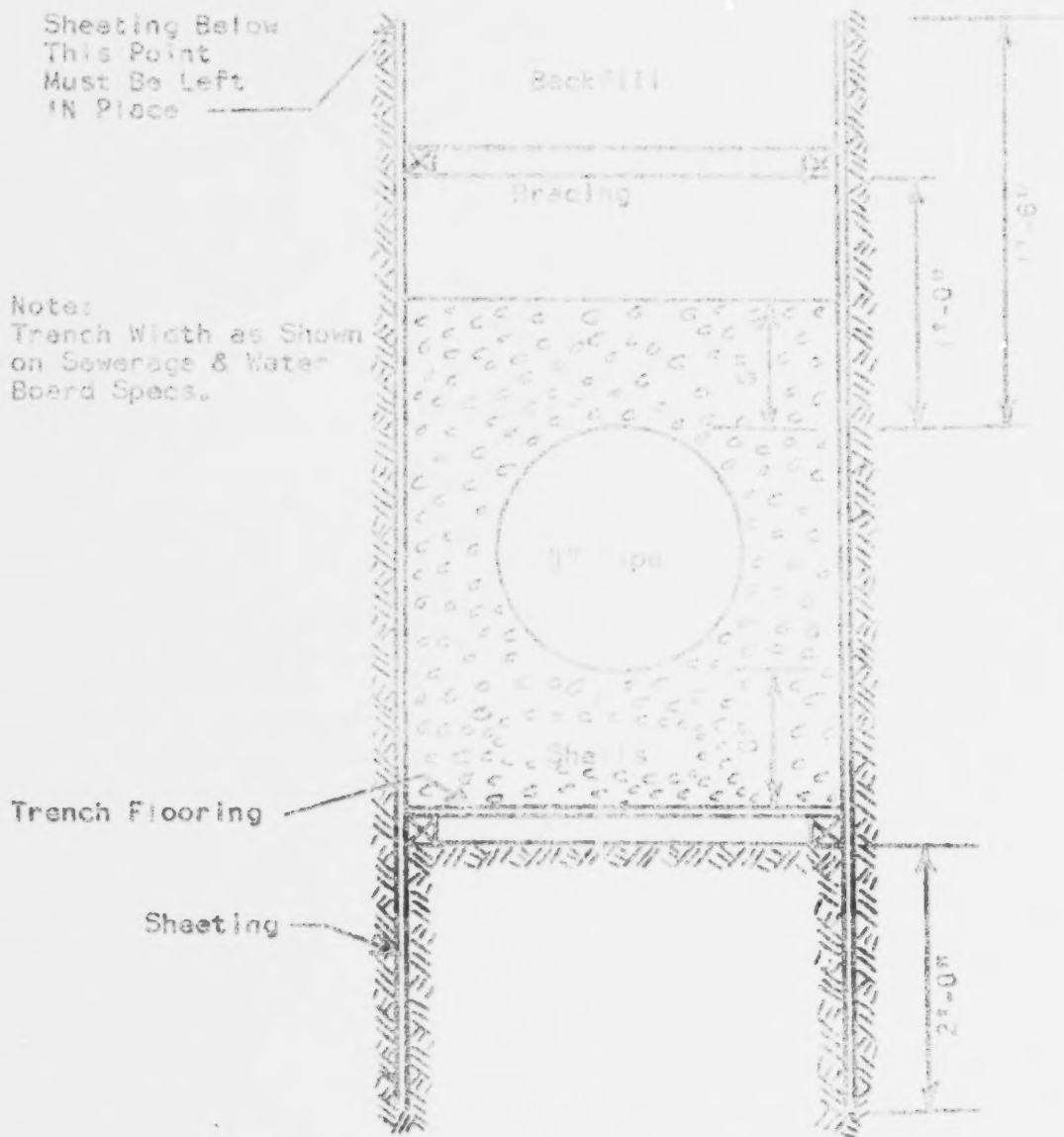
by reason of cost. Additional materials were found to be unsuitable for sewer work because of their impracticability in placement. Others could not be used because of their toxicity on exposure to the atmosphere and the possible danger to men working in the sewer trenches.

The range of materials was systematically narrowed until it included only sand, shell, portland cement and bentonite. The control tests, to be mentioned later, were then applied to various combinations of these materials.

It was found that with the bedding mixtures tested, the shear strength after 24 hours following mixing did not vary appreciably from mixture to mixture. This is explained by the fact that all mixes possess a skeletal matrix of shell. It would therefore be reasonable to expect the mixes to possess a shear strength of at least that of shell. Those mixes that contained portland cement will gain shear strength with time. This was observed qualitatively on material which was stored after its removal from the shear box. None of the material mixes chosen for these tests exhibited any adverse shear phenomena.

One of the characteristics of an ideal bedding is its inability to transmit significant amounts of water. Permeability tests were utilized in comparing the materials relative to their water transmission characteristics.

On the basis of the shear tests and the permeability tests, the beddings for the field study were chosen. Three different beddings were ultimately used in the field installations. These beddings are shown in Figs. 5, 6, and 7.



NEW ORLEANS SEWERAGE & WATER BOARD
STANDARD BEDDING

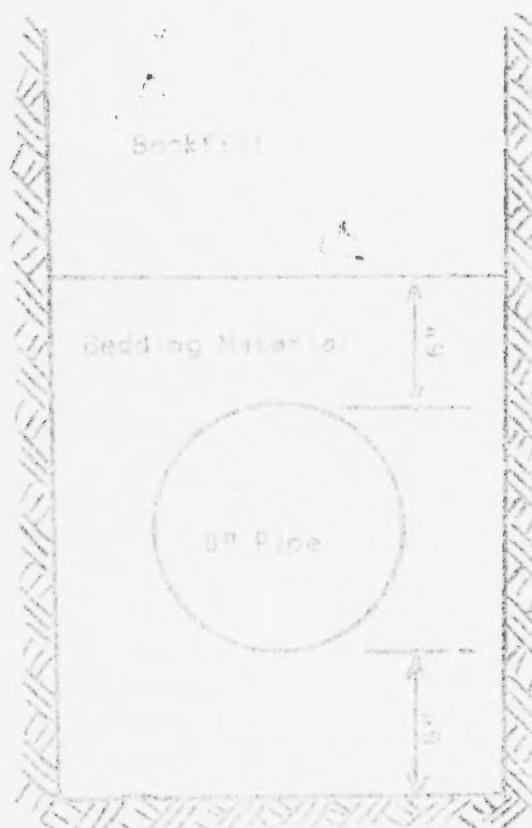
FIGURE 5
Bedding Arrangement "A"-- Control

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Notes:
Sheeting If Needed
as Needed

Notes:
No Timber Flooring
In Trench

Notes:
Minimum Trench Width
as Shown on Sewerage
& Water Board Specs.



BEDDING MATERIAL (by volume)

Sand-----	47%
Shell-----	47%
Portland Cement-----	6%

FIGURE 6
Bedding Arrangement "B"

Notes:
Spacing 1" Bedded
as Needed

Notes:
No Timber Flooring
in Trench

Notes:
Minimum Trench Width
as Shown on Seepage
& Water Board Specs.



BEDDING WATER AT	
Sand-----	10%
Gravel-----	15%
Portland Cement-----	6%
Bentonite-----	7%

The first bedding (see Fig. 5) is the control for the field study. It consists of the New Orleans Sewerage and Water Board's "Standard Bedding" and is representative of the foundations used in the Gulf Coast area. All other beddings and arrangements will be compared to this control.

The second and third arrangements are shown in Figs. 6 & 7. They consist of mixtures of sand, shell, portland cement and bentonite. Both of these beddings have been designed so that their properties of tightness and strength will be enhanced with time.

Sewer Settlement

Settlement readings were taken on the test sewers. To date the settlement of the Iota Street installation has been negligible. Settlement readings for the Hessmer Avenue installation are not yet complete. Fig. 8 shows a schematic of a settlement gage.

Infiltration Tests

Infiltration tests have been and are still being run on the test sewers. Fig. 9 shows the infiltration test results to date for both installations.

Television Inspection

A television inspection was made of the Iota Street sewer, and such an inspection will be made shortly of the Hessmer Avenue installation.

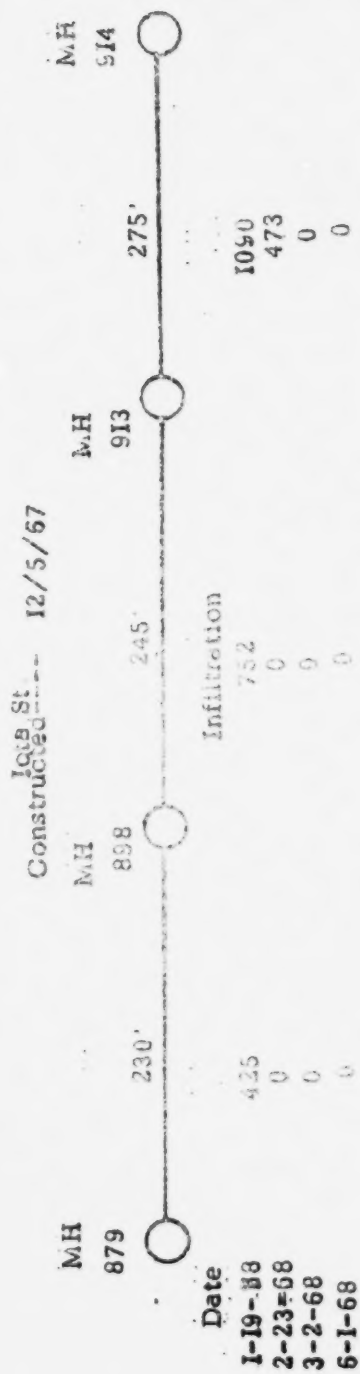
Support Tests

Laboratory control tests were run as aids in determining the bedding materials to be used in this field study. Two different tests were developed

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INFILTRATION FIELD STUDY
FIG. 9

Note: Infiltration Reported in gal./inch of diam. / mille / day

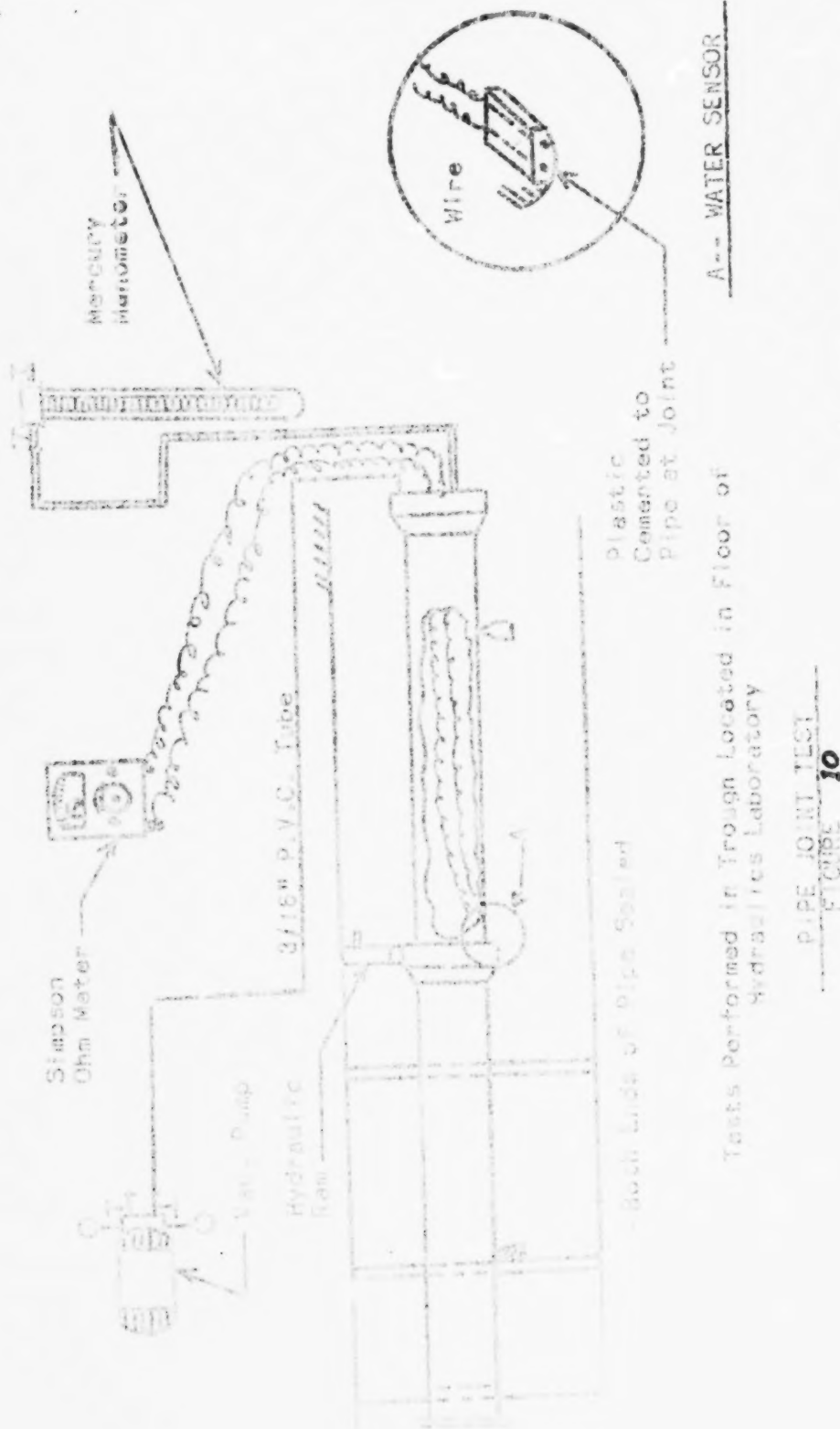
and employed, a shear test and a test for an index of permeability. The procedures for these tests was described in detail in the 1967 annual report.

Pipe Joint Tests

A test has been designed at Tulane to determine the angle of pipe deflection at which the sewer joint will leak under any given head. This test was run only for the eight inch pipe and joint used in this study. The test consist of deflecting two pieces of pipe at the joint and recording the angle at which leakage occurs. The pipe was submerged in a tank with approximately one foot of water coverage. Various heads were produced by drawing a vacuum on the inside of the pipe. The presence of leakage was determined through use of an electronic water sensor. The head was measured through the use of a mercury manometer. A schematic diagram of this test is shown in Fig. 10.

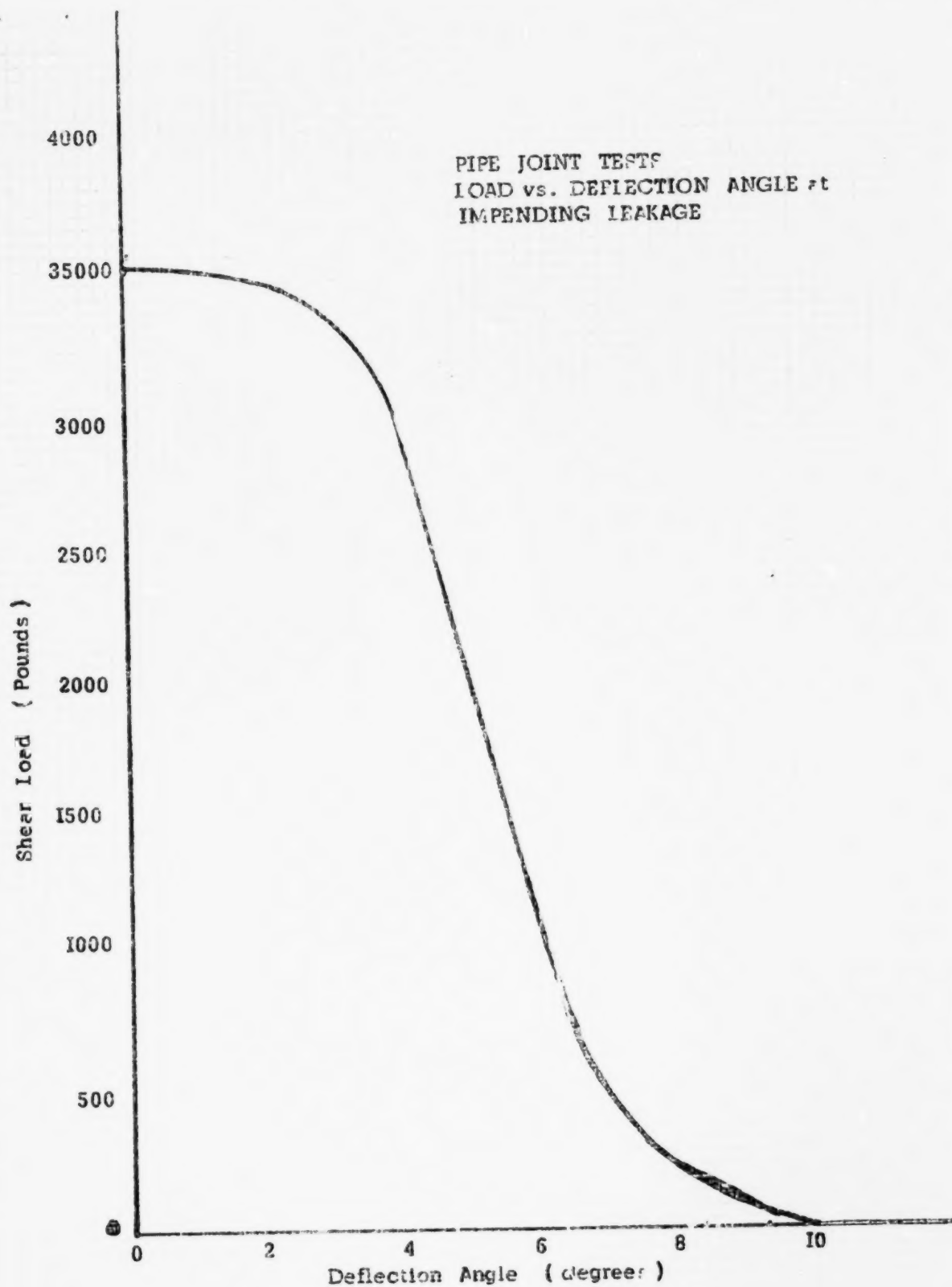
An additional set of these tests were run at the W. S. Dickey Clay Mfg. Co. research laboratories in Pittsburg, Kansas. These tests took shear load into account as a key factor in producing leakage.

The testing carried out was designed to determine the interrelationships at impending leakage for external load, hydrostatic head, and the angle of joint deflection. It was found that for the range of values studied the deflection angle at leakage was independent of the hydrostatic head and dependent upon the external load applied to the joint. Fig. 11 shows the relationship between the angle of impending leakage and the externally



Tests Performed in Trough Located in Floor of
Hydraulics Laboratory

PIPE JOINT TEST
FIGURE 10



applied shear load.

QUESTIONNAIRE STUDY

During 1968, a questionnaire study was completed of sanitary sewers in the Gulf Coast area. A summary of the results of this study is appended.

APPENDIX

SUMMARY OF QUESTIONNAIRE STUDY

GULF COAST AREA

Tulane University
Department of Civil Engineering

40 Municipal sewer authorities answered out of 71 queried for a 56% reply

Sewers

Total Length	13,569 miles
Clay (factory joints - 2754 miles other - 5989 miles	8,743 miles
Concrete	4,479 miles
Plastic	14 miles
Cement Asbestos	216 miles
Other	116 miles

Beddings

7 Municipal authorities used no bedding at all.

The following tabulation shows the frequency of use of bedding materials for the sampled municipalities. Some municipalities indicated that more than one type of bedding was commonly used.

Clam and Oyster Shell	16
Gravel	8
Crushed Stone	7
Sand	4
Cement Stabilized Sand	3
Board Bottom	5
Piles	5
Concrete Encasement	3
Slag	1
Sand & Shell Mixed	1

Infiltration

The dry weather infiltration of those reporting this type of information, ranged from 2% to 60% of their total flows with an average of 14.27%.

The infiltration averaged 7996 gpd per mile of sewer.